AN OVERVIEW ABOUT INFORMATION TECHNOLOGY TO PRODUCE TRACEABILITY IN THE WINE

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Abstract: *Traceability is a mechanism to identify the origin of a product from the field to the consumer, depending, or not, of transformation or processing. The aim of this paper is to present the state of the art about the use of information technologies applied to traceability in the supply chain of wine and their associated regulations and laws designed to ensure that they are met in an innovative, efficient, and applicable way. The implementation of the traceability process on the supply chain of wine and using of new technologies to apply the controls, achieves a quality management that benefits both producers and consumers.*

Keywords*: quality management, regulations, agribusiness, supply chain.*

1. INTRODUCTION

The safety and quality of food are gaining significant attention by consumers and producers, and consequently has stimulated the adoption of mechanisms for identification and traceability.

Traceability is a prevailing topic in nowadays and provides many opportunities for improvement in the various processes related to agribusiness. The concept of traceability relates to information, physical separation, and quality control of foods.

When seeking the meaning of tracking, we concluded that is to capture, and to exchange information about products along the supply chain, from the source of their production process to the final consumer. In addition to streamlining the identification, control and removal of products that may pose risks, locate faults and take corrective action, the traceability process, makes their use as important factor to ensure that the final product has only materials and components of quality [1].

In this context, the ability to prove the authenticity of the wine in real time by querying a database using the product code is certainly an important differential of manufacturer. An efficient tracking process should consist of quality standards that aim to ensure and preserve the productive process, procedures, list of permitted and prohibited inputs, grace periods or transition-based standards, audits, and inspections and periodic surprises [2]. This paper provides the result of a study aiming to review the state of the art about the use of information technologies applied to traceability in the supply chain of wine and their associated regulations.

2. TRACEABILITY

The traceability process for companies of distribution and retail from segments of the food industry, becomes a competitive edge, strengthening the corporate image of the company, assisting in positioning the brand in the market, encouraging competition through differentiation and quality of products. [3].

Traceability has several purposes, being the principal, allow the return of the product when necessary, troubleshoot and take corrective measures minimizing costs. Although for some people the history of incidents involving wine consumption does not seem very worrying in the matter of food safety, there are reports of incidents in the United States where it was necessary to remove products from the market due to contamination that caused problems consumer health. In these events underscores the importance of the existence of the traceability process that allowed to determine the affected lots, making it unnecessary gather entire production [4].

2.1 Major regulations related to traceability

The importance of traceability process in the food chain gained momentum from the 1990s. Incidents involving the consumption of beef from animals affected by "mad cow disease" led the European Union to create the Regulation 178/2002 laying down the general principles and requirements of food law and establishes that traceability must be ensured at all stages of production, processing and distribution of foodstuffs.

Due to the beneficial properties of wine to health, a law was proposed in Brazil in 2005, in order to consider the wine a functional food in Rio Grande do Sul State, but it was vetoed in October 2006 by the Legislative Assembly.

The wine is considered food product in European Legislation, hence, Brazilian producers who export to any country in Europe should adopt the process of traceability for their products. For companies that adopt quality standards such as ISO (International Organization for Standardization), product traceability is an important item to be implemented to achieve certification. This standard traceability is "the ability to recover the historical, application or location of an activity or a process, or a product or an organization registered through identifications" [5].

The ISO organization is the national leader in establishing global standards, creating in 2007 the ISO 22005, for food and beverage, consisting of a complete traceability on which each processor can be certified. The ISO 22005 establishes general principles and basic requirements needed to implement a traceability system throughout the production chain.

With the enactment of that resolution the indication of origin is granted by the INPI (National Institute of Industrial Property) for products of unique quality, in view of the natural features (like mesoclima of its origin) and human (as the manual processing and handcraft). Thus, we know the origin of the product and the same is attested with a certificate of quality.

The firsts brazilian wineries with indication of origin recognized by the INPI are located in the Rio Grande do Sul State, its producers being associated with APROVALE (Association of Producers of Fine Wines of the Vinhedos Valley) [7]. In 2007, the European Union recognized the Geographical Indication of Vinhedos Valley, which represented a new stage for the wines of the region, facilitating the access of

European consumers. In recent years the INPI has worked to demarcate an area of approximately 174 km^2 for the Indication of Altos Montes Origin. Since 2009 a special process is used for traceability of Italian wines known as 'PDO - Protected Designation of Origin' [8]. These wines are certified and receive labels after physical and chemical analyzes verifying the quality standards prescribed in regulations. Thus, the consumer can query the data source of lots, the results of the analyzes, as well as other information from the production process. These labels can be: DOC (Denomination of Controlled Origin) and DOCG (Denomination of Controlled and Guaranteed Origin), show in Figure 1. The latter is to name the most famous and highest quality, recognized for at least ten years as DOC.

Figure 1 – DOCG and DOC labels for wines.

To meet the demands of the international market, Brazil created regulations to organize its production system by the Normative Instruction nº 20 of 27/09/2001. General guidelines were defined for the IPF (Integrated Fruit Production) program ensuring traceability of fruit production processes [9]. This program was launched by EMBRAPA (Brazilian Agricultural Research Corporation) and is aimed at obtaining a traceable process for the production of fruit. It corresponds to a set of good agricultural practices that need to be recorded so that the producer can be accredited in it. Since 1999, through the merger of several national and international institutions with EMBRAPA, it was implemented the tracking system of the Integrated Production of Grapes Fine Table (PI-Grape). Thus, 14 export companies grape, associated with VALEXPORT (Association of Exporters of Horticulture and Derivatives San Francisco Valley), were selected to participate in the program and its PI-grape producing units were subdivided, identified and georeferenced by GPS (Global Positioning System). One benefit for the producer who is certified in the PIF is the possibility of increasing the opening to the international market due to allow for greater system reliability of product quality, as well as the traceability thereof [10]. In this context, whether for legal, economic, or political health, producers are increasingly looking for processes that allow people to get information on the traceability of its products to meet consumers and ensure greater participation in the local, regional and global market.

2.2 Evolution of Technological Innovations for traceability

Information technologies are constantly evolving in order to meet the needs of producers and consumers of wine in search of records that add quality to the final product. This quality is related to food security and economic issues as well, since the presence of traceability tools such as labels, barcodes and other controls allow to identify fakes.

In 2004, a system was developed in Lavras - Minas Gerais State - [11], which allows to query information from the production of wine through the series, number and year printed on the bottle label. The developed system aims to enable the recording of information from planting to marketing the grape wine as the grape variety planted, type of fertilizer, so the wine production, a result of the chemical analysis, time aging, bottling process, among others, to ensure greater security and transparency for consumers, show in Figure 2. The main motivation for creating this system was to try to make the Brazilian wines more competitive against imported, considering the increasing demand for traceability process after the Regulation nº. 178/2002.

Figure 2 - Screen Wine System "Story of a bottle" with the information found on the internet.

Another technology that is being used to meet the requirements traceability is the Radio Frequency Identification (RFID) [12], performed using radio signals, accessing information stored on tags or labels. The access is performed remotely through wireless devices called readers. The information from the RFID tags need not be in line with the reader to be accessed and thus may be incorporated in an item placed within containers or implanted in the plant. This technology has a greater reach for reading, often hundreds of meters away and at a speed of more than a hundred labels per second, and new developments promise to 1000 tags per second [13].

The RFID technology was used in a project perform in 2009 in the Petrolina city - PE to data storage and control of the wine production process [1]. The project consisted of placing tags on boxes where the grapes are accommodated for transportation and readers were arranged in the form of portals, thus forming a magnetic field. Each label passing through the portal is read automatically, checking in and out of the boxes in the freezer.

An innovation of the applicability of RFID technology in supply chain traceability of food occurred in 2010 with the use of labels inside the plants vine. These labels have a diameter of 2.11 mm and 12 mm long, show in Figure 3. This technique brings no impact on the vine vitality and allows monitoring and the storage of useful data that can be used in the tracking process, for example, plant identification, cultivation practices adopted, historical treatments, procedures agronomic and photos, and can still be edited data according to the need.

Figure 3 – Chip RFID compared to a grain of rice [14]

The integration of RFID technology with a GIS (Geographic Information System), allows to create a digital map representing the "virtual vineyard", making possible to access data from the vine selected [15]. In 2011, a research was performed by two wineries located in Italy and Spain, which produce wines with different characteristics, since the quality depends greatly on the type of soil, climate and plant. They consider that all steps performed during the production affect the flavor of the wine, and thus the collection and storage of data for a traceable process has great value, not only for the consumer but also for the owner of the winery. The implementation of this traceability system was possible thanks to the joint use of RFID technology, a network of wireless sensors to measure climate botanicals data and a software developed for data management.

In Table 1 is shown the flow of the traceability system with the phases of the production process where the data to be tracked is collected and their technologies adopted. This table was adapted from the original paper [16].

Table 1. Flow traceability system

	Stage of the production process of wine	Technology adopted for data collection	Data collected automatically
1	Vineyard	Wireless sensor	Climatic parameters (temperature) and botanical parameters (leaf wetness, soil moisture)
2	Grape harvest	RFID	Location of Origin
3	Entry in the cellar	RFID	Temperature, Humidity
4	Dump site	RFID	Location
5	Pressure	RFID	Volume
6	Decantation, Fermentation, Conservation	RFID	Results of Chemical Analysis
7	Treatment	RFID	Type of treatment, processing time
8	Harmonization	RFID	Type of treatment, processing time
9	Bottling	RFID	Date, Data capping, labeling process
10	Storage	RFID	Location ,storage time

Once a bottle of wine is produced and receives the barcode or QR (Quick Response - a two-dimensional barcode that can be easily scanned by mobile), the stored data are available for the consumer to access the history of the wine bottle acquired.

Other technological innovations are being researched and developed. As a sample, in 2011 it was started a project by UTAD (University Tras-os-Montes and Alto Douro) in Portugal aiming to develop a method of identifying varieties through DNA extraction from grape [17].

Wines can be produced from one or more varieties of vine and this is the characteristic that most influences the quality and value of the product. Wines with denomination of origin, such as PDO wines, are obtained 100% from grapes of the species *Vitis vinifera*. This method allows to verify that the label matches what is in the bottle of wine, enabling the detection of counterfeits or labeling errors. The sample is frozen for implementing processes of centrifugation and extraction of the various components. In 2012 began the second stage of the project, called Wine Biocode [18], with the goal of identifying how much of each variety was used in a particular wine.

These technological advances when developed to meet the regulations and with the focus on collective use of members, adds value to the product meets consumer demands for access to provenance information and production process that are not specified on the labels of bottles and mainly ensure traceability requirements.

3. FINAL CONSIDERATIONS

The traceability in the supply chain of food is important for producers and consumers, as it is a requirement for quality and safety food. Many regulations were created from the 1990s, and since then the development of technologies to meet this requirements are in constant innovation. The creation of the Integrated Fruit Production (IFP) Program in Brazil has been a great ally to the development of systems for traceability seen the importance of obtaining a certificate by producers to export growth. Barcode and labels technologies have been used, although many research opportunities may still be developed to enable them to be improved in terms of performance and cost. It is important to note that beyond the legal requirements surrounding this case, the consumer is increasingly appreciating the possibility of having access to information and this should be a strong motive for producers seek innovations in this area.

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